all taxonomic systems. But terminology must, in general, be of a sort that can be employed in systematic botany as well as in the departments of pure morphology or organography.

The attempt to construct an organography of plants upon adaptational or epigenetic lines must always be fraught with difficulties, some of which the author has not successfully avoided, but in general the work is most illuminating. A particularly useful chapter is that on symmetry, in which, it should be noted, there is included an independent paper by Dr. A. Weisse on the mechanical principle involved in leaf arrangement. The somewhat variant views of Schwendener and Vöchting are given due weight and discussed with much critical acumen. The part of this chapter dealing with the dorsiventral shoot is one of the few really satisfying chapters in botanical literature. Anisophylly, asymmetry and plagiotropy in general are given a most adequate and instructive treatment. Various species of *Selaginella* are reviewed, and the laws of leaf arrangement upon dorsiventral shoots are largely explained from plants of this one genus.

Of all five chapters, however, the third seems to the reviewer, upon the whole, the most original and valuable. Here Dr. Goebel incorporates his own results to a very considerable degree, and gives the first connected and philosophic account, in botanical literature, of seedlings. After his fashion in his earlier work upon plant development, he includes in the same breath discussion of gametophytic and sporophytic structures—a feature very repugnant to the reviewer —but, nevertheless, manages to leave no point untouched by a wealth of allusion and example, so that when the chapter is finished the reader feels that he never understood seedlings before. The spirit of the enquiry is altogether different from the drier and essentially formal tone of Sir John Lubbock's well-known book. It is philosophical, suggestive and inspiring.

Nothing particularly new or strikingly helpful is to be found in the closing chapters of the first part—those on malformations and on correlation—for the positions taken are quite exactly those of Sachs, and differ principally from Sachs, in treatment, by the examples chosen.

In general this work is one which will be everywhere regarded as well maintaining the transcendant reputation of its author.

Conway MacMillan.
University of Minnesota.

A Course in Experimental Psychology, Part I.: Sensation and Perception. By Professor Edmund C. Sanford. Boston, D. C. Heath & Co. 1898.

Professor Sanford has achieved a difficult task. A laboratory course may be most carefully planned beforehand, but upon trial it will be found quite inadequate in numberless ways ; it is only after repeatedly using the course with successive classes, and most carefully correcting and improving it each time, that there is any reasonable security for the hope that the exercises will work smoothly. This series of elementary experiments is the successful result of many years of development in Professor Sanford's laboratory course at Clark University.

The earlier portion of the book (first published in 1894) covers the dermal senses, the kinæsthetic and static senses, taste, smell, hearing, the eye, light and color. The later portion (just issued) treats of visual perception. Some few of the exercises are rather physiological than psychological, but there is no objection to touching upon related problems ; even books on physics are accustomed to discuss briefly the anatomy of the eye and the optical illusions. The experiments begin with qualitative ones of a most elementary character ; *e.g.*, " Touch yourself in several places with the same object, and analyze out, as far as you can, the particular quality of the sensation by which you recognize the place touched. This quality of a sensation is known as its ' Local Sign.' " A few pages further the experiments become somewhat more elaborate ; still further they require apparatus, and so on. In fact, they are carefully graded to increasing difficulty, without ever becoming too difficult for an elementary class. The suggestions in regard to apparatus are, in general, good, although some improvements might be made here ; *e.g.*, it is doubtful if the joint-sense apparatus or the Ellis harmonium is worth the cost ; if the large wooden pieces, such as tilt board and rotation table, are worth either the cost or the space, etc. The

steel cylinders referred to on p. 381 are quite accurately tuned by Koenig by a special method. In general, it may be said that one of the most expensive ways of getting pieces of apparatus is to have them constructed by 'any carpenter;' *e.g.*, the time required to explain the construction of the Wheatstone stereoscope to an ordinary carpenter, the inevitable use of unseasoned wood, and the high wages demanded by the American workman, make the result ruinously expensive. Successful apparatus can be furnished at reasonable terms only by a conscientious workman under the supervision of the scientist. Can we not hope that Clark University will again add to its reputation by establishing a special mechanic who can make the material for this course under Professor Sanford's personal supervision? This will aid in the introduction of elementary laboratory work throughout American institutions.

In conclusion, it would be hard to overestimate the labor, care and skill that show themselves in every line of Professor Sanford's book; as an elementary laboratory course it is not only a pioneer—it is at the same time a brilliant success. It is to be hoped that this Part I. will be followed by a Part II., which shall serve as a second-year course of a quantitative character; the subject of Time—which has been, I believe, promised for this part—lends itself readily and elegantly to this method of treatment.

As an episode in the history of science this book marks the introduction into psychological work of the elementary qualitative laboratory method which has, for example, been so successful in chemistry; it also bears some resemblance to elementary courses in physics given in some high, normal and grammar schools. It is, of course, not intended that such laboratory work should form the whole of the psychological instruction; a more general treatise would probably be read at the same time, such as Ladd's *Outlines of Descriptive Psychology*, or Titchener's *Primer of Psychology*, or, possibly, my own *New Psychology*, with the omission of the couple of difficult chapters on statistics and color. This elementary qualitative work should be followed by most carefully planned exercises in elementary psychological measurements; at Yale such a set of thirty exercises has been designed to teach such elementary concepts and methods as 'average,' probable error,' 'function,' 'plotting,' determination of constant errors, compensation of progressive errors, in addition to the usual psychological concepts and observations in touch, hearing, sight, time, etc. This course, in turn, should be followed by advanced work in psychological measurements analogous to that in astronomy, geodesy, etc.; such a course includes a discussion of probabilities, statistics, least squares, etc., and their application to psychological work. With the completion of Professor Sanford's book and the appearance of more advanced laboratory manuals we may hope to find the methods of instruction as well systematized in psychology as in physics or chemistry.

E. W. SCRIPTURE.

SCIENTIFIC JOURNALS.

The Journal of Geology for April–May, 1898 (Vol. VI., No. 3), contains the following papers: 'Chemical and Mineral Relationships in Igneous Rocks,' by Joseph P. Iddings. Professor Iddings continues the interesting discussion of the chemistry of igneous rocks by means of plotted curves, which was begun in a previous number. He first establishes the formulas and molecular ratios of the chief rock-making minerals. Next from a series of diagrams which are plotted by using silica-percentages as abscissas and the ratio of the molecular ratios of alkalies to silica as ordinates for a great number of rock analyses, illustrations and curves of extreme mineralogical composition are drawn. They serve very neatly to localize and group within limits many rock analyses of more complex relationships and cast much light on the minerals that must result in the crystallization of maqueas whose composition is known. 'The Weathered Zone (Yarmouth) between the Illinoian and Kansan Till Sheets,' by Frank Leverett. This weathered zone is most pronounced and best recognized in the region between Davenport, Iowa, and Quincy, Ill. Its character is illustrated by various well-sections. 'The Peorian Soil and the Weathered Zone (Toronto Formation),' by Frank Leverett. A bed of muck and weathered soil, for which the